

Title: Grasping at Graphs

Brief Overview:

In this unit students will gather and use real-life data to find measures of central tendency. They will also use the data to construct stem-and-leaf plots, and box-and-whisker graphs. Real-life situations and higher-level thinking problems are used as motivational techniques.

Link to Standards:

- **Problem Solving** Students will use various types of problem solving techniques such as brainstorming, real-world modeling and solving an easier problem within in a cooperative environment and using technology.
- **Communication** Students will be able to explain the procedures used to create graphs and display data. They will also be able to analyze and draw conclusions about their graphs and justify answers to posed questions through writing. Discussions about the problems, and what they mean in the real-world will also take place.
- **Reasoning** Students will use their ability to reason mathematically to answer higher-order thinking questions, make predictions and reach conclusions about data and graphs.
- **Connections** Students will make connections to the real-world in various problem solving situations, such as determining whether or not a board game is feasible and selecting the best members for a sports team based on their overall statistics. Connections to writing, science and economics are also made.
- **Number & Number Relationships** Students will compute the mean, median, mode, range and quartiles for given sets of data. Students will work with whole numbers, fractions, decimals, and percents in order to analyze data and draw conclusions about distribution of graphs.
- **Algebra** Students will look for relationships between data sets and patterns in graphs.
- **Statistics** Students will collect, organize and interpret data. They will use the data to find measures of central tendency. They will construct line plots, stem-and-leaf plots and box-and-whisker graphs.
- **Measurement** Students will measure their height and their shoe size in centimeters. Students will also use their measuring and estimation skills to predict data points.

Grade/Level:

Grades 7-8

Duration/Length:

This activity will take 6 to 7 days. The activities may take longer than anticipated depending on class duration and students' prior knowledge.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Arithmetic operations (+, -, \times , \div)
- Number sense
- Measurement of objects using the metric system
- Creation of line plots
- Scale setting for graphs
- Entering data into the graphing calculator

Objectives:

Students will be able to:

- work cooperatively in groups.
- collect and organize data.
- find measures of central tendency.
- construct stem-and-leaf plots and box-and-whisker graphs.
- interpret graphs and explain their implications in the real-world.
- solve problems and give appropriate support for their answers.

Materials/Resources/Printed Materials:

- Pencils
- Paper
- Graphing Calculator (TI-82) Note: TI-80 may also be used.
- Student worksheets 1-6
- Teacher resources 1-2
- TI-82 directions

Development/Procedures:**Day 1:**

- Working in pairs, measure height and shoe size in centimeters.
- Fill in height and shoe size chart, Worksheet 1.
- Find the mean, median, mode, and range as a class for the height data.
- Find the mean, median, mode, and range independently for the shoe size data.

Day 2:

- Find the mean, median, mode, and range for soup prices by hand, Worksheet 2
- Follow the directions for finding mean, median and range on the graphing calculator.
- Solve soup example as a class on the graphing calculator.
- Finish Worksheet 2--both the calculator and paper and pencil are used.

Day 3:

- Predict how many times a student can stand and sit in a minute, writing it on a post-it.
- Create a stem-and-leaf plot for the class predictions on the chalkboard.,
- Conduct an experiment to find the actual value for each student.
- Create a back-to-back stem-and-leaf plot using the actual data.
- Show the class part of a stem-and-leaf plot for animal speed.

- Make predictions about which animal might correspond to which data point.
- Complete Worksheet 3 on animal speeds.

Day 4:

- Create a human box-and-whisker graph based on student height (see Teacher Resource Sheet 1).
- Circle median, put a box around each quartile, and put a triangle around each extreme value for three sets of data, as a class (see Teacher Resource Sheet 2).
- Define what an outlier is, and how to determine if there is an outlier in your data.
- Use manipulatives and Worksheet Set 4 to create a box-and-whisker graph for a set of data.

Day 5:

- Demonstrate how to make a box-and-whisker graph on the graphing calculator.
- Complete basketball activity, Worksheet Set 5.

Evaluation:

Day 6:

- Complete assessment activity, Worksheet Set 6.

Extension/Follow Up:

- Encourage students to find examples of data in their textbooks, newspapers or sporting magazines that could be organized using line plots and box-and-whisker graphs.
- Find newspaper or magazine articles that have examples of misrepresented data.

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Worksheet #1

Student	Height (cm)	Shoe Size (cm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		

Name: _____ Date: _____

Finding Measures Of Central Tendency Worksheet #2

1. Find the mean, median, mode, and range for the soup prices (given in cents).

Soup Prices -- 60 , 52 43 , 89 , 75 , 78 , 71 , 55, 64, 66, 58, 69

Mean

Median

Mode

Range

2. Using the graphing calculator, compute the mean, median, mode and range for these distance in miles to some major cities from Washington D.C. -- **956, 659, 765, 576, 968, 659, 765**

Mean

Median

Mode

Range

3. Show how you would find the mean, median, mode, and range by hand. Check your answer using the graphing calculator.

Quiz Scores-- 50, 74, 90, 86, 86, 66, 90, 98

Mean

Median

Check

Check

Mode

Range

Check

Use the following list of data to answer each question.

Portable CD Players

<u>Brand and Model</u>	<u>Price</u>
RCA RP-791	\$86
Panasonic SL-S290	\$134
RCA RP-7926A	\$125
Panasonic SL-S490	\$195
Sony D-141	\$89
Sony D-335	\$283
Sony D-143	\$110
Craig JC6111	\$68
JVC XL-P41	\$136
Fisher PCD-60	\$183
Sony D-421SP	\$258
Aiwa XP-33	\$94
Onkyo DX-F71	\$179
Kenwood DPC-151	\$263
Magnavox AZ 6827C	\$149
Kenwood DPC-751	\$213
Emerson HD6825	\$85

Source: Consumer Reports 1995

4. Use your graphing calculator to find the following:

Mean

Median

Mode

Range

5. What does the median tell you about the list of CD prices?

6. What does the mean tell you about the list of CD prices?

7. What other information would you want to know about each CD player, before you make your decision about purchasing one?

Name: _____ Date: _____

Stem-and-Leaf Plot on Animal Speed Worksheet #3

The speeds for 18 animals are given below in mi/h. Use this information to answer the questions that follow.

Antelope	61	Hyena	40
Cat (domestic)	30	Male deer	35
Cheetah	70	Pig (domestic)	11
Coyote	43	Quarter horse	48
Elephant	25	Reindeer	32
Elk	45	Squirrel	12
Giraffe	32	White-tailed deer	30
Gray fox	42	Wild turkey	15
Grizzly bear	30	Zebra	40

Source: Prentice Hall Middle School Mathematics, Overhead Resource Guide, 1993

1. Create a stem-and-leaf plot that displays each animal's speed in mi/h.

1 |
2 |
3 |
4 |
5 |
6 |
7 |

2. Calculate the mean, median, mode, and range for the animal's speed.

mean=

mode=

median=

range=

3. If a race car's top speed is 112 mi/h, where would it be placed on the stem-and-leaf plot?
4. Why are there three zeros on the three stem? Could you display the speed of 30 just once on the three stem? Why or why not?
5. Are there a large amount of numbers on any certain stem? Why or why not?
6. What do you predict man's top speed to be? On what stem would you place him?
7. What do you predict a rabbit's top speed to be? On what stem would you place it?

Name: _____ Date: _____

Box-and-Whisker Basketball Activity
Worksheet Set #5

Through this activity you will choose one of the following players to put on your basketball team. Below you will find the number of points scored for three different basketball players, over a ten game season.

<u>Bob</u>	<u>Harry</u>	<u>Marge</u>
10	17	5
20	19	9
15	19	28
12	18	20
17	17	21
9	17	15
22	18	10
11	17	18
16	19	12
15	18	19

1. Create a box-and-whisker graph for each player. In order to better compare the players, create one scale at the bottom of the page that would be suitable for all three box-and- whisker plots. Then answer the questions on the following pages.

Use your graphs to answer each question. Use complete sentences and support your answer.

1. Which player has the smallest range of points? How do you know?

2. Which player has the largest range of points? How do you know?

3. Compare and contrast the upper extremes. What does this tell you about the players?

4. Why aren't there any whiskers for Harry's graph?

5. Why does Bob's graph have one long whisker and one short whisker?

6. Compare and contrast the lengths of the boxes. What does the length of the box tell you about the players?

7. Which player would you want on your team? Explain.

HUMAN BOX -and- WHISKERS

Teacher Resource Sheet 1

Materials: yarn

surveyor's tape or a different color yarn

adding machine tape or register tape

signs

Signs should be printed as follows: **MEDIAN, UPPER QUARTILE, LOWER QUARTILE, UPPER EXTREME, LOWER EXTREME, OUTLIER** (2 of these)

Procedures:

1. Have students line up horizontally across the front of the classroom from shortest to tallest.
2. Beginning at the extremes, students pair-off until the midpoint is reached. Have students step forward in pairs counting toward the middle. The middle student (or pair of students) are acknowledged as Miss/Mr. Median and they should hold the sign for median.
3. The process is repeated with the upper half to find the upper quartile, and with the lower half to find the lower quartile. They hold up the appropriate signs.
4. Place a piece of register tape on the floor in front of the students representing a number line marked from 60 inches to 78 inches (or in centimeters). Have students line up behind their height. Students holding signs should be in front.
5. Pose the following questions to students: Are there any outliers? What do we look for to determine if there is one? Hand signs to the lower extreme, upper extreme and any outliers.
6. With the surveyor's tape, box in the region bounded by the upper and lower quartiles. Then, attach the whiskers to the box with yarn and extend to the extremes.

NOTE: This process can be repeated using other data collected such as foot size.

Teacher Resource Sheet 2

Directions: In each set of data, circle the median, put a box around the upper quartile and the lower quartile and put a triangle around the lower and the upper extreme. Remember to put the data in numerical order and be careful, the answer may not be one of the listed numbers.

Example 1: Number of People at Music Hall Concerts

120 128 126 130 140 157 164 110 90 89 165

Example 2: Baseball League Scores

4 9 4 3 8 1 3 0 7 3 5 1

Example 3: Automobile Gas Mileages

31 27 12 23 45 24 39 19 48 24 20 22
29 17 34

Example 4: Environmental Club Member Ages

55 46 31 22 10 16 22 31 46 17 23 32
19 25 33 37 28 27 34

FINDING MEAN, MEDIAN AND RANGE ON THE TI-80/TI-82 CALCULATOR

TO ENTER DATA IN LISTS:

1. Press STAT ENTER.
2. Clear existing lists by pressing THE UP ARROW CLEAR ENTER.
Arrow over to L2 and repeat above steps.
3. Arrow back to L1 and enter the data (information). Press THE RIGHT ARROW KEY and enter data in L2 . Continue until all information is entered.
4. Hit 2nd MODE (QUIT) to quit and return to home screen.

TO FIND THE MEAN OF A SET OF DATA:

1. Press the 2nd STAT keys.
2. Arrow over to MATH.
3. Arrow down to 3: mean, hit ENTER (or just hit 3)
4. Enter the list of which the mean is to be found, by hitting 2nd and the number of the list.
Close the parentheses.
5. Hit ENTER.

TO FIND THE MEDIAN OF A SET OF DATA:

1. Press the 2nd STAT keys.
2. Arrow over to MATH.
3. Arrow down to 4: median, hit ENTER (or just hit 4)
4. Enter the list of which the median is to be found, by hitting 2nd and the number of the list.
Close the parentheses.
5. Hit ENTER.

TO FIND THE RANGE OF A SET OF DATA:

1. Press the 2nd STAT keys.
2. Arrow over to MATH.
3. Arrow down to 2: max, hit ENTER (or just hit 2)
4. Enter the list of which the maximum is to be found, by hitting 2nd and the number of the list.
Close the parentheses.
5. Hit the subtraction key.
6. Press the 2nd STAT keys.
7. Arrow over to MATH.
8. Arrow down to 1: min, hit ENTER (or just hit 1)
9. Enter the list of which the minimum is to be found, by hitting 2nd and the number of the list.
Close the parentheses.
10. Hit ENTER

DIRECTIONS FOR MAKING A BOX AND WHISKERS PLOT ON THE TI-82/TI-80

TO GET TI-82 READY TO WORK:

1. Press MODE .
2. Make sure that all the left hand side is highlighted
(NORMAL,FLOAT,RADIAN,FUNC,CONNECTED,SEQUENTIAL,
FULL SCREEN) ***NOTE: this screen is different for the TI-80
3. Hit Y= , clear out any existing equations by hitting CLEAR.

TO ENTER DATA IN LISTS:

1. Press STAT ENTER.
2. Clear existing lists by pressing THE UP ARROW CLEAR
ENTER.
Arrow over to L2 and repeat above steps.
3. Arrow back to L1 and enter the data (information). Press THE
RIGHT ARROW KEY and enter data in L2 . Continue until all
information is entered.

TO DRAW A BOX -and- WHISKER PLOT:

1. Press 2 nd Y= ,
2. Make sure that all STAT PLOTS now read as off.
3. Go to plot 1 and press ENTER.
4. Turn on PLOT 1 by highlighting ON and hitting enter.
5. Turn on whisker plot, arrow down to TYPE, placing the cursor over the third diagram and pressing ENTER.
6. Arrow down to XL and highlight LI press ENTER.
7. Arrow down to Freq and highlight 1 press ENTER.

TO SET YOUR WINDOW SO YOUR GRAPH LOOKS GOOD:

1. Press WINDOW
2. Arrow down to Xmin and hit 0
3. Arrow down to Xmax and place in an appropriate maximum for your data.
4. Arrow down to Xscl and hit in 1.
5. Arrow down to Ymin and hit 0.
6. Arrow down to Ymax and hit 10.
7. Arrow down to Yscl and hit 1.

***** PLEASE NOTE: ZOOM STAT MAY ALSO BE USED TO
AUTOMATICALLY SET THE WINDOW

FINAL STEP: HIT GRAPH.

GRASPING AT GRAPHS ASSESSMENT

INTRODUCTION:

You are a production design assistant for the ABC Games Inc. One of your colleagues has just designed a game called FLIP CHIP. Your design team has been assigned the job of deciding whether the game would be an appropriate product for distribution and for which age group it is most appropriate.

At the conclusion of this task you will be asked to write a report to your boss communicating your conclusions about the FLIP CHIP game and supporting your recommendation for the game with graphs and data.

ACTIVITY 1:

With your group, brainstorm the activities you could do to aid in the decision making process, include types of data and graphs you might use to support your conclusions.

THINGS YOU CAN DO	DATA/GRAPHS YOU COULD USE

ACTIVITY 2A:

As design assistants, the first thing you may want to do is play the game so that you know more about it.

First you will need to gather the needed materials for your game.

You will need:

5 score sheets (use five sheets of paper two numbered with 1's ,
two numbered with 3's and one numbered with a 5)

1 chip or coin *** NOTE: coins will roll and slide

One student will need to keep track of the scores.

Set up the targets on the floor in this layout :

1
3
5
3
1

RULES FOR THE GAME:

1. Each student gets five flips of the chip.
2. Each student must stand five feet from the targets.
3. Record your score by totaling the points you receive in five flips.
4. If your chip does not land on a target you get 0 points.

QUESTION:

If each team member plays the game only once will you have enough data to support a decision and make proper graphs? Why or why not?

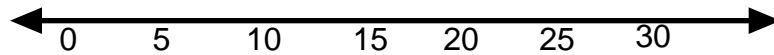
ACTIVITY 2B:

Your team has decided that it wishes to collect data for each member playing the game four times. Do this and record your scores below:

NAME	GAME 1	GAME 2	GAME 3	GAME 4

***ACTIVITY 2C:**

Make a line-plot for all of your scores using the scale below.



QUESTIONS:

1. How would you use the range and mode to describe your scores?

2. Are there gaps on the line plot? Why or why not? _____

ACTIVITY 3:

Using the stem given below create a stem and leaf plot of your data.
Remember to order your leaves.

0	
1	
2	
3	

QUESTIONS:

Find the range, median and mode for your stem and leaf plot.

Range= _____

Median= _____

Mode= _____

How are the stem-and-leaf plot and line plot alike? How are they different?

ACTIVITY 4:

Now divide your data into two groups, girls scores versus boys scores. Create a back-to-back stem and leaf plot to compare the data. Remember to order your leaves.

	0	
	1	
	2	
	3	

QUESTIONS:

1. How do the two groups compare? (You may wish to talk about mean, median, mode, range and outliers.)

2. In what other situations could you use a back-to-back stem and leaf plot?

ACTIVITY 5:

Use your original set of data to create a box and whiskers plot below.

(HINT: Remember to write your data in order first, draw a scale and label your intervals) Note: You may wish to use a graphing calculator to check your work, where possible.

QUESTIONS:

1. What does the box -and -whisker plot show? _____

2. What fraction of the data is below the lower quartile? _____
3. What fraction of the data is below the median? _____
4. What fraction of the data is below the upper quartile? _____
5. If you had one member of your team flip another chip and record their score, would your median change? Why or why not?

6. How many points did the typical student score? _____

7. Compare the percentages inside the box with outside, how do the percentages relate to each other? _____

ACTIVITY 6:

Now that you have collected data, answer the following questions:

Do you think the game is appropriate for distribution? Why or Why not?

What age groups do you think this game should be recommended for? Why?

What data and graphs would you use to support your teams decision to your boss?
Why?

ACTIVITY 7:

Using the information you have gathered in this activity write a report to your boss communicating your conclusions about the FLIP CHIP game and supporting your recommendation for the game with evidence from collected data and graphs.

TO : Ms. Abc, Vice President of Production and Design

FROM: _____

DATE: _____

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

